

# PENETRATING WOUNDS OF THE CHEST, PERFORATING THE DIAPHRAGM, AND INVOLVING THE ABDOMINAL VISCERA.

CASE OF SUCCESSFUL SPLEEN SUTURE FOR TRAUMATIC HÆMORRHAGE.

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PENETRATING wounds of the thorax, perforating the diaphragm, and involving the abdominal viscera stand in a class by themselves, presenting features which require immediate decision in diagnosis and departures in treatment not generally advocated or practised. They are discussed in the text-books and literature from a diagnostic point of view, and the treatment most generally advocated is conservative, doubtless on account of the uncertainty of positive conclusions as to the organ or organs involved, and as well the greater uncertainty as to operative results.

Penetrating wounds of the chest, above and not involving the diaphragm, are of common occurrence, and are met with almost daily in the wards of the larger hospitals in cities. They form a very important part of the work of the active surgeon, and are eminently important and intricate, from their very necessary vital relations. In diagnosis many of them baffle interpretation. In treatment only the exceptional one bears active interference.

In comparison with the abdomen or brain, the thoracic region is an uncultivated field. Men who are bold in invading other parts of the body, hesitate, palliate, procrastinate, and often withdraw, when confronted with a penetrating wound of the chest, especially when it involves the abdominal viscera. The same hesitancy long controlled operators in dealing with penetrating wounds of the abdomen and organs in the upper

peritoneal space, and even at this time cases are seen of penetrating wounds of both lower chest and abdomen where a proper estimate cannot be made of the extent of the injury to the contained viscera, and they are treated conservatively with uncertain results.

Whether this reluctance is from the teachings of our textbooks,—a large majority of which advises against operating in penetrating wounds of the chest,—or whether it is the rarity of cases, and consequent lack of experience in this particular region, is a matter to be determined. The fact is plainly apparent that these almost surely fatal wounds, many of them fairly easy to reach, are abandoned with a sterile dressing, a strapped chest, a dose of morphine, and no investigation as to the possibility of interference.

A penetrating wound of the chest below the sixth intercostal space, in the great majority of cases, should be investigated, not by probe or a finger, for neither can give one accurate information. The probe in such wounds should be discarded; the finger, by the possibility of infection and the admission of air and consequent pneumothorax, is far less accurate than the *resection* of a rib, where by actual observation a positive diagnosis can be made and direct treatment instituted.

In the cases here reported, it would never have been possible to determine the extent of the injury, had not resection of a rib been made.

In wounds below the sixth rib the important questions to be decided at once are: Has the diaphragm been perforated? Have the abdominal viscera been wounded? If it is decided that they have not, by what process of reasoning were the facts determined?

If it is decided that they have been wounded, what organ or organs are involved in the thoracic or abdominal cavities, and to what extent?

These are the intricate problems to be met with almost without hesitation, and on these conclusions depends one's future action.

In any penetrating wound of the thorax, anterior, posterior, or lateral, my experience has been—and that experience is borne out by the cases herein presented—that it is impossible to be accurate in estimating the extent of injury done to the viscera on account of the variable height of the dome of diaphragm, and the presence of the omnipresent omentum, which I found in every instance had temporarily plugged the wound openings in the diaphragm, and for the time masked the symptoms. In the cases referred to here there were penetrating wounds of the thorax through the diaphragm with serious involvement of the abdominal viscera.

American authors are strictly conservative in the management of wounds of the chest with or without abdominal complications. Senn, in his most recent work, written after his large experience in the Spanish-American War, says, "We have made but little progress in the treatment of penetrating wounds of the chest."

Direct operative treatment of visceral wounds of the heart and lungs is always attended by imminent risk to life from pulmonary collapse. This source of danger stands in the way of direct treatment of visceral wounds of the chest. Free incision of the chest wall has been strongly advocated by several French surgeons, in cases of penetrating gunshot wounds of the chest, with a view of arresting hæmorrhage by ligation, tamponage, or the use of cautery; but the profession as a whole, for good reasons, is opposed to such heroic treatment. Unless the source of hæmorrhage is one of the intercostals or internal mammary arteries, it is advisable to rely on Nature's resources, aided by such means as will favor thrombus formation in arresting the bleeding. As to treatment, he says further, "From what has been said, it is clear that the best treatment in penetrating wounds of the chest consists in hermetically sealing the wound of entrance and exit, if the latter exists, under strict aseptic precautions, immobilization of the chest by bandaging and rest, and in watching for and treating subsequent complications as they arise."

Thirty-three standard works on surgery—twelve English,

twenty-one American—express the same conservatism in the treatment of chest wounds, and as a matter of assumption include those of the diaphragm and abdominal viscera. Scant reference is made to this complication in any of them.

On the other hand, French and Italian surgeons advise and practise immediate interference in penetrating wounds of the chest, in wounds below the sixth intercostal space, and in heart and visceral wounds not immediately fatal, but not in gunshot wounds passing clear the body.

The recent and valuable work of Lejars on "Emergency Surgery" fixes clearly the practice in France in penetrating wounds of the chest involving or not involving adjacent viscera.

French and Italian surgeons investigate and operate in indicated cases, and their results show the wisdom of their practice.

There is one practical point, so very vital in the management of chest wounds with abdominal complications, upon which some stress should be laid. An American authority of note advises and recommends, in operating on chest wounds where the diaphragm has been perforated, that a thorough examination of the abdominal contents be made by enlarging the opening in the diaphragm. This, I think, is highly impracticable, and while it can be done it is not satisfactory.

This manœuvre I have tried in two of my cases, and in each instance it gave me limited information, and proved a detriment to the patient, on account of the necessity of enlarging the opening in the diaphragm. It is as indefinite and as unsatisfactory as it would be to determine a lesion of the abdominal viscera with a finger inserted through a small wound of the parietes.

My first operative case was done in 1891, for a stab wound through the sixth left costal cartilage, cutting the internal mammary arteries, pericardium, and heart. In this case, through a trap from the sternum, costal cartilages, and ribs, a radical operation was done, and the patient was alive five years afterwards.

In twenty-six cases of complicated wounds of the chest involving the diaphragm, the first ten, except one heart case, died from non-interference, of the remaining number two died within three hours of hæmorrhage, one from a perforating wound of the heart, one from embolism, and three from sequential infection. Of the remaining thirteen, one died one year after operation, and two after a lapse of eighteen and twenty months, respectively. The others are living. The remaining seven were operated upon after the manner to be detailed in this paper. From this experience, I am convinced that a large proportion of the cases of penetrating wounds of the chest should be followed out to the end of the wound, just as are abdominal penetrating wounds, and treated surgically.

In gunshot wounds of the chest where the ball has passed clear through the body, or into the body without causing an early fatal issue, the best practice is not to probe, but to clean the opening or openings and seal. This is the practice laid down by the most advanced workers in military surgery, and is a safe rule to follow. But there are exceptions to this practice, exceptions based on fundamental findings, often to be found if looked for, and one of which will be cited.

It is not my purpose to discuss military surgery or gunshot wounds of the chest, but as one of the cases to be referred to is a complicated case of gunshot wound of the chest, and one which I think would have surely died had he not been subjected to operation, I feel that it is a case directly in point, and one so exceptional that it will prove of more than ordinary interest in the study of penetrating wounds of this character.

These cases have been selected from my work with special reference to the illustration of the different types of chest wound complications.

The first is a gunshot wound, the ball striking the eighth rib, perforating the diaphragm, bisecting the left kidney from pole to pole, cutting the ureter and trunk of the renal artery, and lodging in the erector spinæ muscles.

Gus D., Irish, aged twenty-four years, was admitted to

Provident Hospital, July 29, 1902, 10 P.M. Shot in the left side while stooping over.

*Examination on Entrance.*—Temperature, 97° F.; pulse, 88, small and compressible. Skin pale and cold, with profuse diaphoresis, marked dyspnoea, and apnoea. Complained of pain on inspiration over the left side of the chest. Blood oozing from wound in eighth intercostal space, two and one-half inches anterior to the left midaxillary line. Vomited frequently until anesthetized. Heart, pericardium, and large vessels negative as far as could be learned. Dulness below third intercostal space. There were no indications of injury to the diaphragm or abdominal viscera, and from the fact that he had been shot through the eighth interspace would almost exclude abdominal complications. Balls do not turn corners unless they come into contact with some hard substance. The ball had passed through the eighth interspace, and it was fair to conclude that its course would vary but little from a straight line.

The omentum had plugged the wound in the diaphragm, and the abdominal and pleural spaces were temporarily normally separated.

Following the practice of examining the urine of all emergency patients while on the table, it was found that the bladder contained twelve ounces of bloody urine. This directed attention to the kidneys and abdomen. Examination of the abdomen showed muscular rigidity on the left side and absolute flatness from the twelfth rib into the flank, and the absence of abdominal respiration, a very important sign in men of a peritoneal lesion. The bladder was washed out, and a second catheterization made, and blood found again. As only one ball had entered the body, it was concluded that the abdominal viscera had been injured through the wound in the eighth interspace, and operation was indicated.

*Operation.*—Incision followed the angle of the eighth rib, five inches long; tissues raised and retracted, subperiosteal resection of about three inches of the seventh and eighth ribs. This gave ample space to reach any part of the diaphragm.

The wound in the diaphragm was treated by a purse-string suture of silk, after the manner suggested by Senn in perforating wounds of the stomach. Over this a continuous Lembert suture.

The pleural cavity was irrigated with salt solution. Wound closed, and the air aspirated with a Davidson syringe.

At this point the treatment of traumatic pneumothorax forces itself into prominence as a factor in estimating the result of the case in hand. In some cases the symptoms from this condition are grave, in others mild. The aspiration of the air from the cavity and a good firm strapping of the chest with plaster have eventuated in all of my cases in success.

Following out the investigation of the perforating wound in the diaphragm, an incision seven inches long was made to the left of the median abdominal line. The intestines and organs were examined with negative results, excepting a bullet wound in the upper inner surface of the kidney. This was closed with continuous suture of catgut, with the idea of protecting the peritoneum from infection incident to any procedure on the bleeding kidney.

An oblique incision was made in the left loin for the purpose of investigating the kidney. When the lumbar fascia was reached, it was found bulging into the wound, and the space dark with extravasated blood. On incising the lumbar fascia, there was an escape of dark clots, followed immediately by profuse arterial hæmorrhage. Temporary deep pressure by tampon controlled the hæmorrhage until the kidney was separated from its surrounding fat, and followed down to the ureter, which, with a large trunk of the renal artery, was found to have been cut by the ball. The kidney was removed. He made a slow but perfect recovery, and remains active and well more than a year after.

The second case is a stab wound of the chest through the eighth interspace and diaphragm and into the spleen. This case adds one more to the very few cases recorded of successful suture of the spleen for traumatic hæmorrhage.

Patient, Alfred C., aged twenty-seven years, was admitted to Provident Hospital, July 30, 1902. Discharged, well, August 30, 1902. Was asked to see and operate upon him by Dr. A. W. Williams.

*Examination on Admission.*—Temperature, 98° F.; pulse, 92, good quality. Complained of pain in and about the wound and in the left abdomen. Short, shrill, hacking cough. Unable

to lie down. Extreme dyspnœa, due to pulmonary collapse. Slight cyanosis. No hæmorrhage from wound on account of valve action of its margins. Heart normal. Dulness over the left abdomen. Slight muscular rigidity. No positive signs of hæmorrhage into the abdomen.

At this examination there were no indications for immediate operation. This is one of that class of cases usually treated on the expectant plan, and always results in death.

From this case, which proved the most interesting and instructive that I have ever met, many useful lessons have come.

After watching the patient for an hour, I concluded to operate on the progressively urgent indications. The pulse had increased from 92 to 140, with lessened tension. There was profuse diaphoresis, increased dulness in the left abdomen, with extreme muscular rigidity, and a leucocytosis of 30,000, his symptoms all pointing to active hæmorrhage.

*Operation.*—Incision following the angle of the eighth rib, retracted over the ninth; resection and method the same as in first case. The wound in the diaphragm was one inch in length, and firmly plugged with omentum; this was reduced by clamping with a pair of forceps, and carried into the abdomen. Wound in the diaphragm was closed, also the costal resection. The skin incision was extended downward over the left lateral abdominal wall into the cavity of the abdomen, which was found full of clots and free arterial blood.

Slight traction on the gastrosplenic omentum enabled me to deliver the spleen on to the abdominal wall for examination. It bled profusely from an incised wound extending from the phrenic to the lower part of the organ. To control the hæmorrhage, a turn of gauze with a drawn loop was put about the pedicle. Here I was confronted with a bleeding spleen. How should it be treated?

My first attempt at suture ended in complete failure by tearing out as I endeavored to draw the suture down. I therefore changed my method by selecting a full, curved, round Mayo needle threaded with No. 2 catgut. This I introduced one-half inch from the margin of the wound edges, and without the least force allowed the needle to follow its full curve, emerging from the opposite side of the wound the same distance as it entered, and making a triple loop without a reënforcing knot. Hot gauze



compresses were held on each loop as the edges were approximated, with the idea of causing the catgut to swell and engage opposing fibres, so as to make a firm line. Every suture put in this manner held firmly.

After watching it for twenty minutes, I returned the spleen to the abdomen, and surrounded it with omentum, a very important part of the detail, on account of its well-known property of protection. The patient made a rapid and permanent recovery. He left the hospital in three weeks. (Fig. 1.)

This case was operated upon in July, 1902. From that time until October, 1903, I had been unable to find a case of successful spleen suture in literature. In November, 1903, Senn's article appeared, and gave the index number of Berger's article and a vast amount of valuable information on this subject. From this reference I have been able to see the original article of Berger's.

Suture of the spleen was first performed by Lamarchia in 1896; his patient died from secondary hæmorrhage. Madelung, in the year following, operated upon a similar case with recovery. Berger's article reports fourteen cases of splenorraphy, with two deaths, and ten cases treated by tampon with one death. Adding my case, we have fifteen cases with but two deaths. This destroys the theory that suture of the spleen for traumatic hæmorrhage is impracticable. Ten cases of tamponade with one death give a choice of two methods of treatment, from which 75 per cent. have recovered. For a method of treatment that had been rejected, abandoned, and discouraged, this is a most excellent showing, and will go a long way in impressing those who may have been sceptical that suture and tampon are the methods of choice for traumatic hæmorrhage of the spleen.

From my very limited experience, I firmly believe that it is the method of the application of the suture, and not the suture *per se*, that has caused the failures. To apply suture to a bleeding spleen as one would to almost any other tissue in the body will certainly eventuate in failure. It requires method, technique, and a proper adjustment of the omentum

in the completion of the operation to have a successful result.

As far as I have been able to learn from the Indexes of the Newberry Library, and the Library of the Surgeon-General's Office in Washington, this is the only successful case of suture of the spleen for traumatic hæmorrhage reported in this country, except the one reported by Tiffany, of Baltimore, in 1894.

The cases abroad are multiplying, and successes are becoming more frequent as technique and method improve.

In the management of traumatic hæmorrhage of the spleen, there are other methods of treatment which are strongly advocated, such as tamponade, cauterization, and forcipressure. Each of these several methods has its strong advocates, and perhaps may be of equal value in efficiency in the final result, but, as the cases are exceedingly rare, it will be a long time before any surgeon will be able to demonstrate the perfection of any special line of treatment, although it now looks as if suture and tampon were the methods of choice.

The third case is added to show the variance of penetrating wounds of the chest. This special type of penetrating wounds below the fifth interspace on either side should impress itself as a most formidable and usually fatal injury. They are wounds that it is positively impossible to diagnose without an exploratory incision until perhaps it is too late. And an exploratory incision here is just as necessary as it would be in a stab wound of the abdomen.

J. P., aged thirty years, referred to me by Dr. A. B. Schutz, stabbed July 30, 1903, through the sixth interspace, one inch anterior to the nipple line. Temperature, 97° F.; pulse, 110, fairly full and regular; respiration, 40; skin cold and clammy. Heart and lungs negative, except below the sixth rib, from which dulness extended downward to the tenth rib. Abdomen negative, arterial blood escaping from the intercostal vessels. As we could get no reliable history of the extent of the wound, exploratory operation was decided upon. Incision four inches long, following

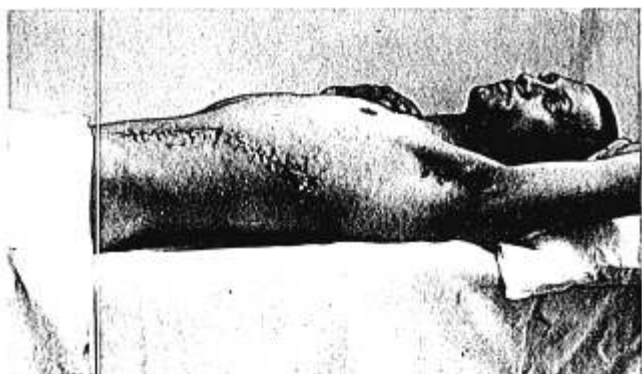


FIG. 1.—Spleen suture; showing line of incision from chest over abdomen to give ample operative field for thorax, diaphragm, and abdomen.

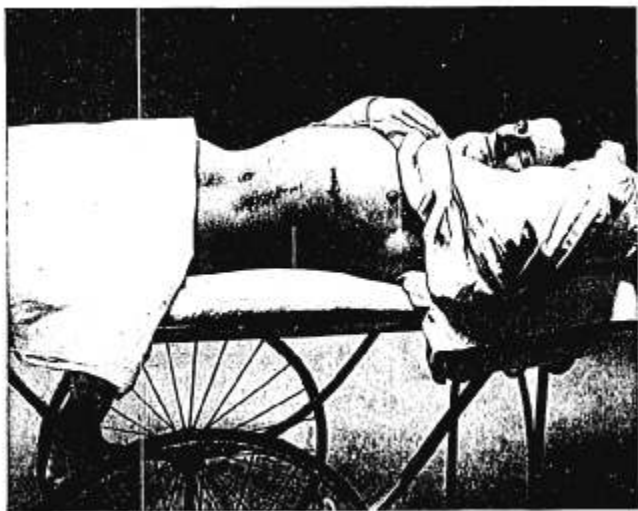


FIG. 2.—Stab wound through thorax, diaphragm, pericardium, and colon. Showing chest and abdominal incisions.

the curve of the sixth rib, retraction of tissues, and subperiosteal resection as described in case one.

On opening the pleural cavity, the patient was dangerously cyanosed on account of the pulmonary collapse, and inability of the right heart to accommodate itself to the emergency.

Two perforating wounds of the diaphragm, one on the outer or pleural side near the dome, and one in a direct line on the inner or pericardial side, were found. Also an irregular wound of the pericardium. No injury to the heart. The diaphragmatic wounds were treated with purse-string silk suture, over this a continuous Lembert. The opening in the pericardium was united with fine silk, the pleural cavity irrigated, and the costal opening closed. I continued the incision below the diaphragm, and carefully explored the abdomen, finding a punctured wound of the transverse colon. This is the only safe practice following penetrating wounds of the diaphragm.

The findings in this case, without symptoms special to any organ or viscera within stabbing distance of the walls of the thorax, again impresses one with the necessity of investigating selected cases of penetrating wounds of the thorax. Had not this case been early operated upon, it is fair to presume that the patient would have died. He recovered. (Fig. 2.)